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Abstract

THE ECONOMIC SEPARATION OF STABLE ISOTOPES ON A COMMERCIAL SCALE

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The separation of isotopes of boron and carbon has been carried out for some time in the U.K. In 1953 work on the separation of boron-10 was started being at that time mainly concerned with the supply of highly enriched BF_3 gas for counter filling. In contrast to the U.S., where a substantial demand existed, the initial European requirement was both small and sporadic. This fluctuating demand required a special approach to plant design in order to obtain an economic production unit. Development has taken the form of a multiplicity of basically independent units as it has been found that they give maximum flexibility from the point of view of output, range of enrichments and utilisation of raw materials.

The technical problems relating to the use of borontrifluoride etherate in chemical exchange/distillation plant arise almost entirely from two of its properties - its highly corrosive nature, particularly in the presence of small amounts of moisture and, its tendency to decompose at quite moderate temperatures. The following developments have been carried out with these limiting properties very much in mind.

Boiler designs, column packing, partial pressure control and extraction methods all affect the operating temperature in direct or indirect ways. Packing of high efficiency with low pressure drop has been developed, new

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boilers have been designed and column head and extraction controls have been improved. The merits of cascade and single step units (enriching from natural abundance to 90% boron-10 in a single stage) are discussed and the latest design of single stage unit outlined. Our present plant consists of 8 such units producing 25 - 30 kg per year. Economic considerations also have an important bearing on design and such aspects as simplicity of operation and construction must be kept in mind. Equilibrium time is particularly important and the units described can be in full production within five weeks of commissioning. Thus a decision to increase production can be implemented relatively quickly.

As far back as 1949 some separation of carbon-13 was being carried out by the U.K. Atomic Energy Authority. The demand is still only of the order of grammes per week and, in the new plant, development has been directed towards economies both in the use of coolant (the main expense in manufacture) and on improving reliability. The commissioning of our new plant has doubled our production of carbon-13 and these developments are fully discussed.